NEVADA DIVISION OF ENVIRONMENTAL PROTECTION

F A C T S H E E T
(pursuant to NAC 445A.874)

Permittee Name: **American Pacific Corporation (AMPAC)** Type of Project: **Remediation**
Project Name: **AMPAC– Athens Road Mitigation System**
Address: **Athens Road and Boulder Highway, Henderson, Nevada. Injection wells are in SE ¼ SW ¼ of Section 25, T21S, R62E, MDB&M, Clark County (along Russell Road Alignment, east of Wiesner Way).**
Permit Action: **Major Modification to UIC Permit**
Permit Number: **UNEV2005213** Injection Wells (#): **Six**

A. Description of Injection

Location: The six injection wells (RIW-2, RIW-3, RIW-4, RIW-5, RIW-7, and RIW-8) are located along Russell Road alignment, east of Wiesner Way, as part of a Groundwater Mitigation System for the Athens Road and Boulder Highway area, Henderson, Nevada. The injection area is referred to as the MW-U Injection Area (MUI).

Latitude: 36° 5' 8.5" N
Longitude: 115° 0' 31.36" W

Characteristics: A variety of electron donors have been shown in the literature to promote the biological reduction of perchlorate including fatty acids (e.g. acetate, citrate, lactate), mixed and pure sugars (e.g. molasses, glucose), protein-rich substrates (whey, casamino acids), alcohols (e.g. ethanol), vegetable oils, and hydrogen gas (ITRC 2005). Natural bacteria use an organic substrate as an electron donor and use the perchlorate molecule as a terminal electron acceptor. The bacteria oxidize the organic substrate to carbon dioxide and reduce the perchlorate to chlorate and chlorite, which is then reduced to chloride and oxygen (Van Ginkel et al. 1996, Kengen et al.1999, ITRC 2005).

The Groundwater Mitigation System consists of:

1. Extracted groundwater (average 30-55 gpm) from six extraction wells on Athens Road, and after the ISB Plant is built, extracted groundwater from three extraction wells in the "Athens Pen Area";

2. Conveyance of the extracted groundwater piped underground to the temporary donor station (western end of Athens Pen) or the In-Situ Bioremediation (ISB) plant (east end of Athens Pen);

3. Filtration of the extracted groundwater using a bag filter system in order to minimize plugging at the injection wells {at the temporary donor station or at the ISB plant};

4. After the ISB plant is built, addition of hydrochloric acid and sodium hydroxide for pH adjustment to a target level of 6.5;

5. Addition of up to two biofouling control chemicals (temporarily at the MUI, then at the ISB plant);

6. Addition of one or more electron donors at the donor station immediately "upstream" of the MUI;

7. Injection of treated groundwater at the MUI into four injection wells with two additional wells providing reserve injection capacity in the event that one of the active wells becomes fouled;

8. Rehabilitation of injection wells will be performed by extraction at the injection wells piped through a return flow line to the ISB plant; and

9. Potable water will occasionally be used to flush the lines of the mitigation system.

The total length of the conveyance system from Athens Road to the MUI is approximately 5,100 feet. It is estimated that the ISB Plant will be operational in December 2005. The ISB Plant will be capable of handling up to 500 gpm of water.

Hydrochloric acid (31% soln. of HCl) and/or sodium hydroxide (NaOH) will be periodically added for the purposes of controlling (lowering or increasing) the pH of the water to mitigate precipitation of minerals in the extraction infrastructure. It is anticipated that the pH of the groundwater will be reduced from 7.0-7.4 to a target of 6.5 through acid addition. According to the permittee, the injection of groundwater with a pH of 6.5 is not expected to have any geochemical impacts in the aquifer due to the buffering capacity of the aquifer. The maximum daily injection mass for all injection wells will be 79 lbs. of HCl and 79 lbs. of NaOH.

The biofouling control chemicals are chlorine dioxide (CAS 10049-04-4) and/or hypochlorite (CAS 7778-54-3). The maximum daily injection mass for all injection wells will be 6 pounds of chlorine dioxide or 22 pounds of hypochlorite for one hour per day. This will minimize the amount of biological induced fouling of the immediate areas around the injection well casings.

The five electron donors are:

1. Sodium benzoate (benzoic acid, sodium salt, benzoate of soda, sodium benzoic acid, antimol), CAS 532-32-1;
2. Citric acid (2-hydroxy-1,2,3-propanetricarboxylic acid, monohydrate), CAS 77-92-9;
3. Sodium acetate (acetic acid, sodium salt), CAS 127-09-3;
4. Sodium formate (formic acid, sodium salt), CAS 141-53-7;
5. Sodium propionate (propionic acid, sodium salt), CAS 137-40-6.

One or more electron donors will be added to the treated groundwater at the injection wells. Sodium benzoate is the primary electron donor that will be utilized, and citric acid is the secondary electron donor. Injection pressures for all injectates will be up to 30 psi. Utilizing the maximum injection rate of 450 gpm, the maximum daily injection mass for all injection wells will be:

1. Sodium benzoate: 270 lbs.
2. Citric acid: 603 lbs.
3. Sodium acetate: 576 lbs.
4. Sodium formate: 1,885 lbs.
5. Sodium propionate: 386 lbs.

With the exception of perchlorate, the injectate shall not exceed Federal or State Primary and/or Secondary Drinking Water Standards or baseline levels, whichever is higher. The ISB method relies upon perchlorate degradation to occur after injection in the subsurface over a period of time. Therefore, the most downgradient performance well PMW-6 may not exceed the perchlorate State Provisional Action Level (currently at 18 ug/L) or baseline levels in the performance monitoring wells, whichever is higher. Monitoring will be implemented to ensure the contamination does not migrate as a result of the injection and to ensure that no significant geochemical changes in the aquifer occur as a result of the injection.

A 3-day tracer test will be performed using about 600 lbs. of sodium bromide, 1 lb. of Fluorescein, and 1 lb. of Rhodamine WT in injection wells RIW-2, RIW-4, RIW-5, and RIW-7 for purposes of hydraulic characterization and to verify placement of monitoring wells. The transport of the bromide ion will be monitored through regular sampling and analysis of the monitoring wells (PMWs) for a period of 4 months, or until the transport of the tracer has been observed to pass the PMWs. The injection concentrations of Fluorescein and Rhodamine WT are below the visible level. Additional tracer tests may be requested at a later date and will require approval by the UIC Program prior to injection.

B. Synopsis

Previously, AMPAC employed Geosyntec Consultants Incorporated (GeoSyntec) to conduct laboratory biotreatability studies using soil and groundwater obtained from locations within the perchlorate plume originating from the former PEPCON facility in Henderson, Nevada (the Site). The former PEPCON facility operated from approximately 1958 until 1988 and manufactured ammonium perchlorate and related propulsion systems. The original PEPCON plant footprint covered approximately 15 acres and AMPAC owned more than 300 contiguous acres.

Geosyntec evaluated whether Enhanced In Situ Bioremediation (EISB) is a viable remediation technology for perchlorate-impacted groundwater at the Site. Results from the laboratory studies demonstrated that the indigenous bacteria in the site soil and groundwater successfully biodegrade perchlorate to environmentally acceptable end products when carbon substrates such as ethanol are added as electron donors. GeoSyntec conducted a field pilot test of in situ bioremediation demonstrating the efficacy of EISB under field conditions on a 1.53-acre parcel of land retained by AMPAC at the southwest corner of Gibson Road approximately 3 miles up gradient of the Las Vegas Wash. Additional bench scale testing showed that the five electron donors listed above could stimulate indigenous microbes to biodegrade perchlorate.

The Groundwater Mitigation System will be installed on land that is adjacent to residential and undeveloped land. There are no producing wells, re-injection wells, springs, mines, quarries, water wells, abandoned wells, or public water supply systems within the 1-mile radius (Area of Review) around the injection wells. There are 24 back-filled boreholes (dry holes) within the Area of Review. The Las Vegas Wash intersects the Area of Review at its northern edge. The Bureau of Water Pollution Control ArcIMS map shows Waste Water Treatment Plant Rapid Infiltration Basins (RIBs) to the southeast of the MUI and the Pittman Wash and another Wash to the northwest. The recent flooding and sewer break in the Pittman Wash (August 15, 2005) is thought to be too far to affect this groundwater mitigation system.

Nine extraction wells (AREW-1, AREW-2, AREW-3, AREW-4, AREW-5, AREW-6, APEW-1, APEW-2, and APEW-3), six injection wells (RIW-2, RIW-3, RIW-4, RIW-5, RIW-7, and RIW-8), and six monitoring wells (PMW-1, PMW-2, PMW-3, PMW-4, PMW-5, and PMW-6) are proposed

for the Groundwater Mitigation System. Extraction wells will provide the perchlorate-impacted groundwater. The injection wells will be used to deliver one or more electron donors to promote in-situ bioremediation of perchlorate.

C. Receiving Water Characteristics:

Groundwater sampling at this site has demonstrated the presence of perchlorate. The sources of groundwater in the region are regional precipitation going through leaky pipes/sewers, residential use (lawn watering), Rapid Infiltration Basins (RIBs), the outflow of the Eastgate Drain and Athens Drain Channel (ADC) surface channels (flood events, weep holes, and French drains). **The weep holes in the ADC currently bring high concentrations of perchlorate-laden water (3-15 ppm) directly to the MUI. Once the extraction wells are operating, it is anticipated that groundwater levels will drop below the weep holes in the ADC, and this source of high perchlorate will disappear.**

The geology at the site consists of two major units: (1) Quaternary Alluvium – Shallow sands and gravels of alluvial origin deposited on the paleosurface of the Muddy Creek Formation that is approximately 5 to 45 feet in vertical thickness; and (2) the Muddy Creek Formation – fine-grained lacustrine facies dominated by silts and clays, but also includes sand layers and lenses. The unconfined aquifer in the Quaternary Alluvium appears to be perched upon the Muddy Creek Formation.

The Quaternary Alluvium is subdivided into three subunits of increasing grain size and permeability (K=hydraulic conductivity): overbank alluvial fan deposits (estimated K=50 ft/day), alluvial fan channel deposits (K=150 ft/day), and Las Vegas Wash deposits (K= 850 ft/day). In addition to the native alluvial deposits, a wedge of coarse-grained artificial fill (K=735 ft/day) is present under Athens Road in the vicinity of previous quarrying operations (backfill). The fine-grained Muddy Creek Facies is thought to have K=1 ft/day based on grain size and professional judgment.

The effective porosity of the Las Vegas Wash Deposits is estimated to be 0.25. The effective porosity for all other units is estimated to be 0.15. The storativity for all units was estimated to be 0.0001. The general direction of groundwater flow is northeast towards the Las Vegas Wash. The hydraulic gradient is approximately 0.03 ft/ft. Depth to groundwater is generally 8-15 feet below ground surface (bgs).

The groundwater quality at this site has demonstrated the following concentrations above Primary and Secondary Drinking Water Standards:

Constituent	Existing Groundwater Concentration	Limit
Perchlorate	2.1 ppm - 53 ppm	0.018 ppm (State Provisional Action Level)
Total Dissolved Solids	4,400 ppm - 6,900 ppm	1,000 ppm (State and Federal Limit)
Chloride	760 ppm - 1,600 ppm	400 ppm (State and Federal Limit)
Sulfate	2,100 ppm - 2,900 ppm	500 ppm (State and Federal Limit)
Nitrate (as Nitrogen)	3.7 ppm - 14 ppm	10 ppm (State and Federal Limit)

Constituent	Existing Groundwater Concentration	Limit
Aluminum	0.060 ppm - 11.0 ppm	0.2 ppm (Advisory State and Federal Limit)
Arsenic	0.031 ppm - 0.093 ppm	0.05 ppm (State and Federal Limit)
Iron	0.36 ppm - 19 ppm	0.6 ppm (State and Federal Limit)
Magnesium	230 ppm - 400 ppm	150 ppm (State and Federal Limit)
Manganese	0.250 ppm - 0.690 ppm	0.1 ppm (State and Federal Limit)
Selenium	0.011 ppm – 0.027 ppm	0.01 ppm (State and Federal Limit)

D. **Procedures for Public Comment**

The Las Vegas Review Journal and/or Las Vegas Sun published notice of the Division's intent to issue a UIC permit authorizing the facility to inject into the groundwater of the State of Nevada on September 29, 2005. The Henderson Home News published notice of the Division's intent to issue a UIC permit on October 13, 2005. Notice of the Division's intent to issue a Major Modification to the permit will be sent to both newspapers for issuance by January 13, 2006. The notice was mailed to interested persons on our mailing list. Anyone wishing to comment on the proposed permit can do so in writing for a period of 30 days following the publication date of the said public notice. The comment period can be extended at the discretion of the Administrator. All written comments received during the comment period will be retained and considered in the final determination. There were no significant public comments that were received.

A public hearing on the proposed determination can be requested by the applicant, any affected state, any affected interstate agency, the regional administrator of EPA Region IX or any interested agency, person or group of persons.

Any public hearing determined by the Administrator to be held must be conducted in the geographical area of the proposed discharge or any other area the Administrator determines to be appropriate. All public hearings will be conducted in accordance with NAC 445A.238.

The final determination of the Administrator may be appealed to the State Environmental Commission pursuant to NRS 445A.605.

E. **Proposed Determination**

The Division has made the tentative determination to issue the proposed permit for a five-year period.

F. **Proposed Limitations and Special Conditions**

TABLE 1

PARAMETER	FREQUENCY	LOCATION	LIMITATIONS
VOCs, using EPA method 8260B (65 compound list)	Once during the first quarter after start-up, then Annually.	At ISB Plant or temporary treatment system: Processed Water Tank Sample. PMW-1, PMW-2, PMW-3, PMW-4, PMW-5, and PMW-6	VOCs must not exceed Federal Drinking Water Standards. Monitor and Report
Perchlorate	Weekly for the first month after startup, then Monthly. _____ Monthly	At ISB Plant or temporary treatment system: Processed Water Tank _____ PMW-1, PMW-2, PMW-3, PMW-4, PMW-5, and PMW-6	Monitor and Report _____ Perchlorate must not exceed the State Provisional Action Level (18 ug/L) or baseline levels, whichever is higher, in the most downgradient performance well PMW-6.
UIC Sample List 1 ("Total Recoverable Metals") using EPA Method 200 and 300 Series; and Total Suspended Solids.	Monthly for the first quarter after startup, then Quarterly. _____ Quarterly	At ISB Plant or temporary treatment system: Processed Water Tank Sample. _____ PMW-1, PMW-2, PMW-3, PMW-4, PMW-5, and PMW-6	Monitor and Report _____ Monitor and Report pursuant to Part I.A.4.d and e.
Dissolved Metals: Aluminum**,** Arsenic, Iron, Magnesium, Manganese, Nickel, and Selenium using EPA Method 200 Series	Monthly for the first quarter after startup, then Quarterly. _____ Monthly	At ISB Plant or temporary treatment system: Processed Water Tank Sample. _____ PMW-1, PMW-2, PMW-3, PMW-4, PMW-5, and PMW-6	Monitor and Report
Alkalinity (Total), Bromide, Chlorate, Chloride, Nitrate, Nitrite, Phosphate, Phosphorous, Sulfate, and Sulfite	Weekly for the first month after startup, then Monthly. _____ Monthly	At ISB Plant or temporary treatment system: Processed Water Tank Sample. _____ PMW-1, PMW-2, PMW-3, PMW-4, PMW-5, and PMW-6	Monitor and Report

PARAMETER	FREQUENCY	LOCATION	LIMITATIONS

Dissolved Oxygen (DO), Oxidation Reduction Potential (ORP), pH, Specific Conductance (EC), Temperature	Weekly for the first month after startup, then Monthly. _____ Monthly	At ISB Plant or temporary treatment system: Processed Water Tank Sample. _____ PMW-1, PMW-2, PMW-3, PMW-4, PMW-5, and PMW-6	Field Measurements Monitor and Report
Injectate: Type of Electron Donor, Max. Daily Injection Mass (for all injection wells), Max. Daily Volume of Injected Groundwater, Max. and Average Injection Rate (gpm)	Continuous Monitoring; Report Daily Values	RIW-2, RIW-3, RIW-4, RIW-5, RIW-7, and RIW-8	See Part I.A.3.c. for Maximum Daily Mass (lbs/day) See Part I.A.3.b. for Maximum Daily Volume Maximum injection of 450 gallons per minute (gpm).
Biofouling Control Compound: Type, Max. Daily Injection Mass (for all injection wells), Volume, Injection Rate	Report Daily Values	Temporarily: RIW-2, RIW-3, RIW-4, RIW-5, RIW-7, and RIW-8 After ISB Plant is built: at ISB Plant	See Part I.A.3.d. for Maximum Daily Mass (lbs/day) Maximum contact time of 1 hr/day.
pH Adjustment Compounds: Type, Max. Daily Injection Mass (for all injection wells), Concentration, Volume, Injection Rate	Report Daily Values	At temporary treatment system or ISB Plant	See Part I.A.3.e. for Maximum Daily Mass (lbs/day) Maximum contact time of 1 hr/day.
Sodium Bromide, Fluorescein, Rhodamine WT	3-day Tracer Test	RIW-2, RIW-3, RIW-4, RIW-5, RIW-7, and RIW-8	Maximum of 600 lbs. of sodium bromide, 1 lb. of Fluorescein, and 1 lb of Rhodamine WT.
Groundwater Elevation (amsl) and Depth to Water	Continuously for 1 week prior to and 4 weeks following startup, then Monthly	PMW-1, PMW-2, PMW-3, PMW-4, PMW-5, and PMW-6	Monitor and Report

G. Rationale for Permit Requirements

The permit conditions will help to ensure that the injectate does not adversely affect the existing water quality or hydrologic regime.

Prepared by: Becky E. Linvill
Date: December 22, 2005; Modified January 6, 2006

REFERENCES

ITRC (Interstate Technology & Regulatory Council). 2005. *Perchlorate: Overview of Issues, Status, and Remedial Options.* PERCHLORATE-1. Washington, D.C.: Interstate Technology & Regulatory Council, Perchlorate Team. Available on the Internet at http://www.itrcweb.org.

Kengen, S. W. M., G. B. Rikken, W. R. Hagen, C. G. Van Ginkeland, and A. J. M. Stams. 1999. "Purification and Characterization of (Per)chlorate Reductase from the Chlorate-Respiring Strain GR-1," *Journal of Bacteriology* **181:** 6706-11.

Van Ginkel, C. G., G. B. Rikken, A. G. M. Kroon, and S. W. M. Kengen. 1996. "Purification and Characterization of Chlorite Dismutase: A Novel Oxygen-Generating Enzyme," *Archives of Microbiology* **166:** 321-26.

APPENDIX A

Inorganic Background and Baseline Data in Area Monitoring Wells (mg/L)

PARAMETER (mg/L)	**SB-2-7 (Background)** Sampled 6/15/05	BMI-AA-21 **(Background)** Sampled 6/15/05	**UC-3 (Baseline)** Sampled 6/15/05	**UC-4 (Baseline)** Sampled 6/15/05	**UYP-11 (Baseline)** Sampled 6/15/05	**DRINKING WATER STANDARDS (MCL)**
Total Dissolved Solids	*** 4400**	*** 6800**	*** 6900**	*** 5100**	*** 5000**	**1000**
pH (units)	7.37	7.11	7.25	7.17	7.17	6.5 - 8.5
Chloride	*** 760**	*** 1300**	*** 1600**	*** 860**	*** 1100**	**400**
Fluoride	1.1	2.0	1.3	2.3	2.6	4
Sulfate	*** 2100**	*** 2900**	*** 2900**	*** 2200**	*** 2100**	**500**
Nitrate (as N)	*** ** 14**	** 7.4	** 9.6	** 7.5	** 3.7	**10 (NO_3-N)**
Nitrite (as N)	** <1.0	** <1.0	** <1.0	** <1.0	** <1.0	1
Aluminum	*** 11.0**	*** 5.80**	0.060	*** 7.30**	*** 0.730**	***** 0.2**
Antimony	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.006
Arsenic	*** 0.093**	*** 0.089**	**0.031**	*** 0.076**	*** 0.053**	**0.05**
Barium	0.340	0.230	0.037	0.130	0.072	2
Beryllium	0.00079	0.00063	<0.00050	0.00067	<0.00050	0.004
Cadmium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.005
Chromium	0.026	0.012	0.0050	0.015	0.0026	0.1
Copper	0.048	0.045	0.037	0.039	0.032	1.3
Cyanide	<0.020	<0.020	<0.020	<0.020	<0.020	0.2
Lead	0.011	0.0035	<0.0010	0.0057	<0.0010	0.015
Iron	*** 19**	*** 7.2**	**0.36**	*** 8.7**	*** 0.91**	**0.6**
Magnesium	*** 240**	*** 400**	*** 340**	*** 270**	*** 230**	**150**
Manganese	*** 0.250**	*** 0.450**	*** 0.670**	*** 0.370**	*** 0.690**	**0.1**
Mercury	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.002
Nickel	0.016	0.0094	0.0076	0.011	0.0057	0.1
Selenium	*** 0.013**	*** 0.025**	*** 0.027**	*** 0.019**	*** 0.011**	**0.01**
Silver	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.05
Thallium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.002
Zinc	0.130	0.027	<0.020	<0.020	<0.020	5

Background samples are outside of the main plume of contamination (perchlorate = 0.067-0.14 mg/L). Baseline samples are within areas where perchlorate is higher (0.34 –3.2 mg/L).

*** Background and/or baseline level exceeds Drinking Water Standard for this parameter.**

** **Sample analysis performed past method-specified holding time due to failing QC in the hold time. May 2005 nitrate data showed a range from 16.4-84.3 mg/L for these wells.**

*** **Advisory standard.**

APPENDIX B

Perchlorate Baseline Data in Performance Monitoring Wells (mg/L)

Date Sampled	PMW-1	PMW-2	PMW-3	PMW-4	PMW-5	PMW-6	STATE PROVISIONAL ACTION LEVEL
9/29/05	1.4	2.8	1.7	2.3	3.9	3.5	0.018
10/12/05	1.3	2.6	1.3	2.0	3.3	3.1	
11/21/05	1.4	2.9	1.3	2.1	3.3	3.5	

Baseline levels for perchlorate in the monitoring wells (PMW-1 through PMW-6) were established during a 3-week period after September 19, 2005.

NOTE: The weep holes in the Athens Drain Channel (ADC) currently drain high concentrations of perchlorate-laden groundwater (3-15 ppm) directly to the MW-U Injection Area. Once the remedial system is operating, it is anticipated that groundwater levels will drop below the weep holes in the ADC, and this source of high perchlorate will disappear.